FIFTY YEARS OF EVOLUTION.

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DURING the past year, 1909, many memorial exercises and celebrations were held commemorative of the centenary of Charles Darwin's birth and of the fiftieth anniversary of the pubcation of "The Origin of Species." Meetings were held by colleges, universities and scientific societies throughout the world, at which many symposiums and addresses were given bearing upon Darwin and his wonderful work and its effect upon science and the world. From some of these addresses I have endeavored to glean material for a brief review of what evolution has accomplished in the last half century, without pretending to any completeness in any direction. It will be an informal talk upon an exhaustless theme. I hope that it may contribute to our better appreciation of the fact that the value of Darwin's work to the world cannot be overestimated. It can only be compared to that of Copernicus and Sir Isaac Newton in its epoch-making influence. His promulgation of evolution as a scientific principle certainly ranks with the copernican theory of the universe and with gravitation in the revolution it produced in the scientific world. All three of these great discoveries mark the birth of new working principles and the inauguration of new methods of thought. Old beliefs and methods were swept aside by master hands and new and wonderful principles were established and new sciences were created. New ways of looking at life and the universe were formulated and the horizon of the human mind was extended. This is especially true of evolution as a new principle of science. How it has extended and enlarged our knowledge of life and of the world within the memory of men now living! Most of us remember the fierce conflict of forty years ago between the teleologists and the evolutionists — popularly known as the special creationists and the Darwinians — and those battles were worth all that they cost in the enlargement and liberty they gave to the human mind. We are freer to-day to say and write what we think because of those battles. More than that, the idea of evolution itself gives a grasp of the universe in all of its beauty and grandeur that the old, rigid conceptions did not confer. We are greater and wiser to-day because of what evolution has done for us. Mankind is on a higher plane and the world is better because of the light that has come to us through a better

understanding of Nature and her revelations of the wonderful methods of the Creator.

The year 1909 was remarkable as being the centennial anniversary of so many great men, not the least of whom was Charles Darwin. Evolution was not a new idea with him, for it had been first suggested by Aristotle and the Greeks. But it had been smothered by the scolastics of the dark ages and only began to blaze forth again in feeble sparks during the first part of the nineteenth century. Several writers had touched upon it, but none studied and systematically accumulated facts bearing upon it until Darwin began his tireless investigations. While he owed much to previous writers for the inception of the idea, what he owed to no one was the application of the inductive method of research, and he stands out as the first who worked upon true Baconian principles. He sought a hundred facts and deductions where his predecessors had been satisfied with but one. His was the matchless genius that crystallized all that had gone before, and added thereto his own stupendous observations, and deduced the great principles for which the world was waiting.

The great storehouse of facts was fairly bursting for want of generalization. The accumulated data of the centuries were all ready to blaze forth into the flame of a great philosophy, and the spark that lit the conflagration was Darwin's great book upon "The Origin of Species." It has been said that the true greatness of a writer consists in the greatness of his theme, and this is especially true of Darwin. His was the genius to give expression to a great thought that was in the air and for which the world was waiting. As the promulgator of the theme of evolution he was the right man in the right place at the right time. He produced immortal work, and the world rightly estimates him as one of the intellectual giants of the English race.

It is now generally conceded that Darwin's "Origin of Species' was the greatest book of the nineteenth century, and this preëminence is accorded to it, not on account of its literary merit—although it is a model of dignity and simplicity and may well be reckoned as an English classic—but because of its far-reaching influence; because the principle of evolution that it established on a firm basis has permeated and revolutionized every domain of human thought. It was a great book because it contained the complete elaboration of a great idea for which the world was waiting, and it was immediately recognized as being great. As you know, Alfred Russel Wallace had the idea of natural selection come to him in the wilds

of the Malay archipelago, independently of Darwin, and wrote to him about it. To be perfectly fair, both had papers read at the same meeting of the Linnæan Society, in July, 1858, so that unseemly controversy about priority was averted—a spectacle which sometimes belittles science as well as scientific men. They were both too great and generous to wish to deprive each other of the honors due to each, and the world has honored them both the more. For twenty years Darwin had been accumulating a mass of data. It was in the air, so that Wallace felt it in far-off Asia. It was a world thought, not the invention of any one man; but the man who gave it complete expression opened up a new era for humanity and made himself immortal. The nineteenth century will be known as the century of unprecedented progress, but not the least of its glories will be the fact that it added to the establishment of the principle of evolution as a great working idea.

In the volume on "Darwin and Modern Science," containing the addresses given at the anniversary exercises at Cambridge last June (Sci., Oct. 15, 1909, p. 527), in tone, all recognized the intellectual supremacy of Darwin, although most of the speakers had made some additions of fact or theory to the verification of evolution. Darwin, they said, was the great explorer who charted the way, and while much of detail has been added to the map, the original chart remains much the same. The scheme of the evolution of species, through variation and heredity, on the one hand, and the selective influence of environment, on the other, has not greatly changed since the date of the "Origin of Species." The method, degree, and to some extent the causes, of variation have been critically and successfully studied. The meaning and the machinery of heredity have been the subject of most fruitful investigation and experiment. Natural selection has been subjected to the most searching analysis, but it still remains the only general cause of the universal phenomenon of adaptation of life to environment. The work of fifty years has but intensified the main features of the sketch, and has constantly added to the work of the master without the obliteration of any essential details.

Darwin's great doctrine was what he called "natural selection and the survival of the fittest," which accounted for the persistence of animals and plants in the struggle for existence. By the workings of these laws the strongest survived and the weaker went to the wall in the battle for life. This crude statement must be greatly modified, however, for there are many qualifying factors entering into its manifestations before it can be considered in its

entirety. Let us listen briefly to what Darwin himself says in "Origin of Species" (I, p. 150):

"If, under changing conditions of life organic beings present individual differences in almost every part of their structure—and this cannot be disputed—and if, owing to the rate of increase, there would be a severe struggle for life—and this cannot be disputed—then, considering the infinite complexity of the relations of all organic beings to each other and their conditions of life, causing an infinite variety in structure, constitution and habits, to be advantageous to them, it would be most extraordinary if no variations had ever occurred useful to each being's own welfare, in the same manner as so many variations have occurred useful to man. But if variations useful to any organic being ever *do* occur, assuredly individuals thus characterized will have the best chance of being preserved in the struggle for life, and, from the strong principle of inheritance, these will tend to produce offspring similarly characterized. This principle of preservation, or the survival of the fittest, I have called 'natural selection.'"

Again (p. 151):

"Natural selection acts exclusively by the preservation and accumulation of variations which are beneficial under the organic and inorganic conditions to which each creature is exposed at all periods of life. The ultimate result is that each creature tends to become more and more improved in relation to its conditions. This improvement inevitably leads to the gradual advancement of the greater number of living beings throughout the world."

Again (p. 153):

"But it may be objected that if all organic beings thus tend to rise in the scale, how is it that throughout the world a multitude of the lowest forms still exist? . . . On our theory, the continued existence of the lowest forms offers no difficulty, for natural selection or the survival of the fittest does not necessarily include progressive development; it only takes advantage of such variations as arise and are beneficial to each creature under its own complex relations of life."

Again (pp. 75–76):

"How have all those exquisite adaptations of one part of the organism to another part, of one being to another being and to the conditions of life been perfected? We see beautiful coadaptations plainly, as in the woodpecker and the mistletoe; in the humblest parasite that clings to the hairs of a quadruped or the feathers of a bird; in the structure of a beetle that dives through the water; in the plumed seed that is wafted by the gentlest breeze—in short, we see beautiful adaptations everywhere and in every part of the organic world."

Again (p. 118):

"Natural selection acts only by the preservation and accumulation of small inherited modifications, each profitable to the preserved being. . . . Natural selection will banish belief in the continued creation of organic beings or of any great and sudden modification of structure."

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Again (p. 132):

"Slow though the process of selection may be, if feeble man can do much by artificial selection, I can see no limit to the amount of change, to the beauty and complexity of the coadaptations between all organic beings and their conditions of life which may have been effected in the long course of time through nature's power of selection, that is, by the survival of the fittest. . . . Natural selection acts solely through the preservation of variations in some way advantageous, and which consequently endured."

Again (p. 164):

"Variability is generally related to the conditions of life to which each species has been exposed during several successive generations."

While the fundamental principle thus brought out and elaborated in "The Origin of Species" revolutionized science and still remains unassailable as a principle, much criticism has arisen of the sweeping application that Darwin made of it during the half century since its promulgation. The application of the idea of natural selection to all kinds of variations is undoubtedly a weakness of the great discoverer. Darwin cites and discusses many objections that were raised in his day, and did not overthrow them all by any means. Other objections have arisen since, so that to-day natural selection and slow modification stands only as one of several methods by which species may have arisen.

One of the most important of these opposing ideas is that of the sudden and spontaneous arising of species, proposed by Prof. Hugo De Vries, of Amsterdam. It is undoubtedly true that the discovery and demonstration of the principle of mutations in the formation of species and varieties of plants by Hugo De Vries, is one of the most brilliant achievements in the history of evolution since the publication of Darwin's "Origin of Species." Its recent promulgation has thrown a flood of light upon many puzzling and obscure questions, and has aided materially in the solution of some intricate problems in the science of biology. Of course there is danger of carrying it too far in its application, like all revolutionary discoveries, for after all it only supplements natural selection and assists in solving problems that that great principle could not account for. It is a source of wonder to later scientists that Darwin, with all his observations and great insight into the workings of nature, should have failed to perceive the idea of sudden mutations, and held it as an inviolable principle that all changes of structure were due to very gradual alterations, the result of natural selection.

So it remained for the astute mind of De Vries to perceive that sudden changes of structure were possible, and under certain con-

ditions could be made permanent. The general acceptance and the revolutionary effect of the idea of the origin of species by mutations has been marvelous, and second only to the revolutionary wave that swept over the world of thought following the publication of the "Origin of Species."

He says of the previous condition of the science of origins (in speaking of Burbank's work) that—

"Of great scientific importance is the question whether repeated selections are sufficient to bring about new forms, and, further, if by this means more variations are produced. We have no facts to indicate this, but it has great importance in the study of conditions. It is closely connected with the question whether species slowly merge into one another or whether they originate by mutations. In the former case small deviations would increase in the course of generations, and thus a long series of intermediate forms would connect man and all other species. In the latter case of mutations a jump is made without any intermediate stages."

The doctrine of mutations is founded upon seven laws, which De Vries thus states:

"(1) New elementary species appear suddenly, without intermediate steps; (2) they spring latterly from the main stem, not affecting it; (3) they attain their full constancy at once; (4) some of the new strains are elementary species, others are to be regarded as varieties; (5) the same new species are produced in a large number of individuals; (6) mutations undergo fluctuating variation, but the latter is not evolution; and (7) mutations take place in nearly all directions."

Like Darwin, his great discovery was founded on experimentation, elaborate and long continued, and he worked upon well-known and familiar facts. Stock-breeders and horticulturists have long employed the method of making permanent the sudden changes that produce variations, but no one before ever attempted to formulate the facts of mutation into a law and to conduct investigations upon such a basis.

Prof. Chas. A. White thus well summarizes the subject in *Science:*

"Species originate from other species through the ordinary function of reproduction, but they each originate suddenly and completely by one mutative act, and not by the slow accumulative variations of individuals. The beginning of the mutative process which is due to some unknown natural determinative cause, some molecular change in the germ-cell of the fertilized ovum, whereby the new individual acquires changed structural characters. The new species thus produced by mutation is in immediate possession of clearly distinguishing and hereditary transmissible characters, and it has no more tendency to hybridize with any other member of the mother species than have other species. Strains thus produced are called elementary species, and differ distinctly but not widely from the mother species."

The claims of the mutation theory are thus as extravagant in that direction as that of natural selection in the other. The truth lies in the medium ground, as usual. Darwin anticipated this idea, to a degree, when he said (Or. Sp., I, p. 313):

"Every one who believes in slow and gradual evolution will, of course, admit that specific changes may have been as abrupt and as great as any single variation which we meet under nature, or even under domestication. But as species are more variable when domesticated or cultivated than under their natural conditions, it is not probable that such great variations have often occurred under nature as are known occasionally to arise under domestication. . . . My reasons for doubting if this can occur, and for entirely disbelieving that species can change in the wonderful manner that is claimed by some, are as follows: According to our observations, abrupt and strongly marked variations occur in our domestic productions, singly and at long intervals of time. If such occurred in nature they would be liable to be lost by accidental causes of destruction and by subsequent intercrossing, as is the case under domestication unless special efforts are made for its preservation. Hence it is necessary to believe that several similarly changed individuals appeared simultaneously in the same district."

Again (p. 316):

"It is claimed that the sudden appearance of new species in geological formations supports the theory, but the admittedly imperfect record of the rocks prevents that evidence from being of any value. . . . He who believes that some ancient form was transformed suddenly, through internal force or tendence, will be almost compelled to assume, in opposition to all analogy, that many individuals varied simultaneously. . . . Against such abrupt changes, embryology enters a strong protest. It is notorious that the wings of birds, the legs of horses and other quadrupeds, are indistinguishable at an early embryonic period, and that they become differentiated later by insensibly fine steps. . . . Hence it is that it is incredible that an animal should have undergone momentous and adrupt transformation and yet should not bear even a trace in its embryonic condition of any sudden modification, every detail in its structure being developed by insensibly fine steps."

A striking book of the past year was that on "Evolution and Pathology," by D. von Hanseman (Sci., Dec. 3, 1909, p. 826), who takes the very original view that, as a ball upon an inclined plane is prevented from rolling by some external hindrance, so species having an inherent and continual tendency to vary are prevented from changing by reason of external conditions. Adaptation means the establishing of an equilibrium between the internal forces and external conditions. The phenomena usually credited with bringing about variations are here regarded as effective agents in checking the inherent tendency to vary. This results, in the long run, in the power for variation being weakened or lost, so that in the highest animals we find great fixity of types. The conditions

throughout nature, as regards the struggle for existence, indicate a compromise of individuals bound by a fundamental law of altruism, which is operative everywhere. These views are striking and impressive, and illustrate the idea that the evolution discussion has been stimulating to originality of thought.

Darwin has been much criticized for his theories of heredity, and yet, as in other branches of biology, his ideas revolutionized this branch and gave thought upon the subject a new trend. For instance, his theory of pangenesis has been condemned as exploded, and yet Weisman's theory of germ plasm is along the same lines and furnishes explanations that nothing else can give. Darwin's theory of pangenesis he explains as meaning (Var. Domes., II, p. 350), "that every separate part of the whole organization reproduces itself. So that ovules, spermatazoa and pollen grains—the fertilized seed, as well as buds—include and consist of a multitude of germs thrown off from each separate part or unit. . . . (P. 378:) According to our hypothesis all forms of reproduction depend upon the aggregation of gemmules derived from the whole body." The power of growth and development, as well as the repair and reproduction of injured and lost parts, especially in lower animals, is fully explained, he contends, by assuming the presence of the gemmules in all parts of the body with particular affinities and tendencies. (P. 397:) "The chief assumption is," he says, "that all the units of the body, besides having the universally admitted power of self-division, throw off minute gemmules that are dispersed through the system. . . . In a highly organized animal the gemmules thrown off from each unit of the body must be inconceivably numerous and minute. Each unit of each part, as it changes during development, must throw off its gemmules. (P. 398:) The units of the body are generally admitted by physiologists to be autonomous. I go one step further and assume that they throw off reproductive gemmules. Thus an organism does not generate its kind as a whole, but each separate unit generates its kind. . . . Inheritance must be looked at as merely a form of growth, like the self-division of lowly organized unicellular organisms." From this lucid statement of his theory, and the logic of it, we cannot wonder that the theories of heredity were completely revolutionized by the promulgation of what he calls his provisional hypothesis.

Following De Vries's principle, and next in importance, was Mendelism — the idea of mathematical proportions in the inherited and transmissible qualities of plants and animals. It was the dis-

covery of Gregor Mendel, a monk of the monastery of Brunn. Born in 1822, he studied natural history in 1851–'53 and became interested in the problems of hybridism, and conducted his classical experiments upon the common edible pea up to 1865. Although the contemporary of Darwin, it is curious that neither knew of the other's work. But as Mendel published but little, his work did not become generally known till 1900, years after his death, when it was discovered in obscure journals, and has been repeated and verified by many experimenters since. According to Mr. R. C. Punnet's book on Mendelism, the classic experiments were first conducted on varieties of the common pea. He bred tall and dwarf varieties of the pea together, and the first offsprings were all tall. These were then crossed, and both tall and dwarfs appeared in the second generation, in the proportion of three talls to one dwarf. Hence he called the talls the "dominants" and the dwarfs "recessives." From these seeds he got dwarfs that bred true in the third generation, but the talls gave some that bred true and others gave seeds that produced both talls and shorts, in the proportion of three to one as before. Subsequent experiments with gray and white mice gave the same results, the gray being dominant and the white recessive. These proportions, with varying details, have been borne out by thousands of experiments with all kinds of plants and animals since that time, by investigators and breeders. As Mr. Punnet says (p. 60):

"The phenomena are of great scientific interest, and the facts elicited by Mendel and others cannot but affect our conceptions of the nature and origin of living beings. Of the fact of evolution we are certain; of the workings of natural selection we have no doubt. But as to the nature of the variations upon which selection works there is much diversity of opinion. The discoveries of Mendel must greatly influence our conception of the part played by the different forms of variations in the evolutionary process. . . . (Pp. 72-74:) We now recognize discontinuity in inheritance as well as in variation. Once a new character has arisen as a mutation, only selection can eliminate it. Mendel's discovery has led us to alter materially our ideas of the evolutionary process. . . . Evolution takes place through the action of selection upon the common mutations. Where there are no mutations there can be no evolution. How and why these mutations arise is the great outstanding problem of biology."

A remarkable recent work was Dr. Frederick A. Woods's, on "Heredity in Royalty," a sociological study of history, in which the privileged class of royal families was taken, as the records are so complete for several generations. (Am. Anthrop., 1909, 529.) They were a high class with a favorable environment. Doctor Woods assumes that the mental, moral and physical make-up of

individuals are the resultant of three causes, *i. e.*, heredity, environment, and free will. But he sums up his investigations in the statement, "The most interesting, and even startling thing has been the ease with which heredity alone has been made to bear the brunt of explaining the general make-up of character." His facts all point to the importance of inheritance as a factor in character, and if so, society must bear the blame, in some measure, for the propagation of the criminal and vicious classes. Biologists, in considering the development of moral qualities by natural selection, have found difficulty in perceiving how altruistic tendencies could be favored by natural selection, but there were correlations observed which would throw light on the subject. He says (p. 513): "The probability is that there are at work forces of natural selection of which we know little of the value as yet, but which are such that, setting aside the influences of environment, whether we will or not, the natural quality of humanity must progress." He says again (p. 515): "The upshot of it all is, as regards intellectual life, that environment is a totally inadequate explanation. We are forced to the conclusion that all the main differences in intellectual activity are due to predetermined differences in the germ cells." Taken all together, Doctor Woods has made us feel that heredity has a much more important part in the determination of character than it has credit for, and the sociologist finds suggestions for the improvement of the race, which, if not feasible now, may be so sometime.

Darwin's influence upon biology in general was most profound and far-reaching. As Prof. Wm. R. Wheeler, of Harvard, in his anniversary address, says (Pop. Sci. Mon., Apr. 19, '09, p. 381):

"Charles Darwin undoubtedly exerted a great and threefold influence upon zoölogy, botany and kindred sciences, first, by his rehabilitation of Lamarck's theory of transformism or evolution; second, by his wonderful studies on variation; and, third, by his brilliant theory of natural selection and the survival of the fittest. . . . (P. 383:) The first effect of the 'Origin of Species' was destructive, as it tended to dissolve the rigid conceptual scheme that dominated not only in zoölogy and botany but the whole cosmogony of the time. The conception of an evolution that melted all living beings into a vital stream that surged on into the future as it has surged through the æons of the past, continually creating new and destroying old forms, could not but clash with a conception of a world created once for all and since engaged in marking time. . . . Evolution, as conceived by Darwin, admitted of a mechanical explanation and so allied itself with the physical sciences rather than with psychology and philosophy. It compelled zoölogists and botanists to attend to every aspect of an organism, every phase of its development, from an egg to its dissolution; nothing in its structure was too insignificant to decide whether a species could survive in

the struggle for existence. Hence the incentive to record the minutest variations and to search for their causes. . . . Paleontology was born anew and the distribution of life in the past and present became the subject of ardent study. . . . The constantly increasing tendency during the last half century to substitute a careful genetic study—that is, a study of all the life processes—for the ancient cut-and-dried methods—has spread far beyond the confines of biology properly so called. . . . (P. 385:) These tendencies have reached not only psychology and philosophy, but even sociology, anthropology, archeology, philology, economics and education. Of course great progress would necessarily have been made in fifty years if Darwin had not revived the doctrine of evolution, but that it dominated and quickened the development theory there can be no doubt. But for the doctrine of evolution we would still be contemplating living organisms from afar, in the scholastic and theologizing spirit of the first half of the nineteenth century, and not, as now, at close range, with a deeper and freer insight into the significance of the minutest details of development, structure and function."

As to Darwin's influence on zoölogy, the one science in which he was preëminent—although he was well accomplished in botany and geology also—Prof. T. H. Morgan, of Columbia University, wrote (Pop. Sci., Apr, 1909, p. 367):

"It is the general belief of zoölogists that Darwin's influence in bringing about the acceptance of the theory of evolution marked a turning point in the history of their science. . . . In the mind of the general public Darwinism stands to-day for evolution, which is generally accepted as Darwin's chief contribution to human thought. To the zoölogist Darwinism means evolution especially as accounted for by natural selection. . . . The example of Darwin's precision in observing, his truthfulness in recording, and wisdom in interpreting has transformed zoölogy from prosaic description to acute speculation—from an interesting study to an aggressive science. This change has taken place in an incredibly short space of time. . . . The loyalty that every man of science feels toward Darwin is something greater than any special theory; it is the spirit of Darwinism, the point of view, the method, the procedure of Darwin. . . . (P. 372:) After Darwin, and largely as the result of the outgrowth of the wide interest his views aroused, there was increased activity in all fields of zoölogy. The systematists, in their intensive study of species and varieties, the geographical and geological distribution of animals, and the influence of environment in modifying species, have supplied the most extensive contributions, perhaps, that have been made to the theory of species formation and transmutation. . . . The morphologists, or philosophical anatomists, form the second group of students whose activity is the result of Darwinism. They have determined the relationship of the great classes of animals on the principle of descent; they have pursued the history of the species in embryology, and have studied heredity in relation to the germ cells that are the links in the chain of organic life. Few other studies have advanced in recent years at so rapid a pace and few have added facts of greater significance. . . . These students have advanced the principles of their science, and the aspect of modern zoölogy is largely the outcome of their varied and far-reaching labors. . . .

(P. 374:) The last twenty years is the brightest chapter in the history, for the spirit of Darwin is once more abroad. . . . Before his time evolution was a general idea, but one of profound significance. After Darwin evolution rested its claims upon a definite body of information relating to variations and their inheritance. It is these data that first convinced his greatest contemporaries of the truth of evolution and finally convinced the rank and file of thinking men. Darwin also opened the doors into unexplored territory, and the rewards in these new fields have been and continue very great."

The bearings of Darwin's discovery upon man and human institutions were most important and revolutionary. Concerning this Mr. Benjamin Kid, in his "Social Evolution" says:

"One of the most remarkable epochs in the history of human thought is that through which we have passed in the last half of the nineteenth century. The revolution beginning with the publication of the "Origin of Species" has gradually extended until it has affected the entire intellectual life of our Western civilization. The sciences dealing with man in society have naturally been the last to be affected, but the changes therein promise to be more startling in character. The whole plan of life is being revealed to us in a new light, and we are beginning to perceive that it presents a single majestic unity, throughout every part of which prevail the conditions of law and orderly progress. We have lived through a period when the very foundations of human thought have been rebuilt. . . . The great triumph of science in the nineteenth century has been the tracing of steps in the evolution of life up to human society."

Prof. F. H. Giddings, in an address upon "Darwinism and Social Evolution," said: "Revolutionizing as the life work of Darwin was in the fields of biology, it is doubtful if his writings were felt anywhere more profoundly than in pre-Darwinian social philosophy." (Pop. Sci., July, 1909, p. 72.) "It was not until the publication of the 'Descent of Man' in 1871, twelve years after the 'Origin of Species,' with its intellectual tempest, that the full significance of natural selection for the doctrine of human progress was apprehended by the scientific world. Mr. Spencer saw it when the 'Origin of Species' was published, and Darwin perceived that he must offer a credible explanation of the paradox that a ruthless struggle for existence could yield the fruits of righteousness. But it was neither of these great thinkers, but a gifted man, Mr. Walter Bageot, who made the brilliant discovery of the final solution, in his 'Physics and Politics.' Mr. Spencer had worked out the idea of savage conflict and the survival of the fittest as applied to individuals in the struggle for existence; but it remained for Mr. Bageot to conceive the idea of group solidarity and collective conflict in distinction from a mere individual struggle for existence. He said: 'The progress of *man* requires the coöpera-

tion of *men* for its development; that man can only make progress in coöperative groups. Tribes and nations are coöperative groups, and it is their being so that makes their value,' etc." Prof. Giddings comments on this view:

"Social evolution thus proceeds through the conflict of antagonistic tendencies, on the one hand, towards uniformity and solidarity, on the other—toward variation and individuality. Mr. Bageot thus arrived at conclusions that we recognize to-day as being at the core of scientific sociology. Society was a factor in the evolution of man before man became a factor in the evolution of society, and the difference is important. . . . In the 'Descent of Man' Mr. Darwin recognizes the utility of group solidarity, and of the struggle of associated individuals to adjust their interest and activities to each other, that the group life may be maintained. To observe the successive stages and the complications of man's collective struggle for existence is to follow the evolution of tribal society and thence the history of civilization. . . . In one favored place, the Athenian city state, society became for a brief period idealistic; that is to say, its bonds were those of a common purpose, or ideal. After 2000 years of arrest and slow recovery, the cosmopolitan society of the Western world is, possibly, once more approaching the Athenian model. And the goal is what? What has evolution done for man? If it be true, indeed, that 'Thro' the ages an increasing purpose runs,' is it made manifest in something that we may legitimately call progress? For progress, rightly defined, is more than evolution. It is either race survival with individuation, or it is increasing individual power, capacity and happiness not entailing race extermination Have we made sure of this? We hate to think ill of ourselves, yet the question will recur, Has the survival of the fit become, at length, the survival of the best."

Of "Darwin's Influence on Philosophy," Prof. John Dewey, of Columbia University, says (Pop. Sci., July, 1909, p. 90):

"The conception that had reigned supreme for 2000 years in the philosophy of nature and knowledge, the conceptions that had become the familiar furniture of the mind, rested on the assumption of the superiority of the fixed and final. In laying hands upon the sacred ark of absolute permanency, in treating forms of life as originating and then passing away, the 'Origin of Species' introduced a mode of thinking that in the end was bound to transform knowledge, and hence the treatment of morals, politics and religion. . . . (P. 93:) The exact bearings on philosophy of the new logical outlook are, of course, as yet uncertain and inchoate. We live in the twilight of an intellectual transition. One must add the rashness of the prophet to the stubbornness of the partisan to venture a systematic exposition of the influence upon philosophy of the Darwinian method. . . . (P. 96:) When Henry Sidgwick casually remarked in a letter that, as one grew older his interest in what or who made the world was altered into interest in what kind of a world it was, anyway, his voicing of a common experience of our own day illustrates also the nature of that intellectual transformation effected by the Darwinian logic. Interest shifts from an intelligence that shaped things once for all to the particular intelligence that things are even now shaping. . . . (P. 97:) The new logic introduces responsibility

into the intellectual life. To idealize and rationalize the universe at large is, after all, a confession of inability to master the courses of things that specifically concern us—a shifting of the burden over to the shoulder of the Transcendent Cause. Philosophy must in time thus become a method of locating and interpreting the more serious of the conflicts that occur in life and a method of projecting ways of dealing with them. . . . (P. 98:) No one can fairly deny that at present there are evident two effects of the Darwinian mode of thinking. On the one hand, there are efforts to revise our traditional philosophic conceptions in accordance with its demands. On the other hand, there is a type of philosophic knowing, distinct from that of the sciences to which they give access, something that radically transcends experiences. . . . Old ideas give way slowly, for they are habits, predispositions, deeply ingrained attitudes of aversion and preference. Intellectual progress usually occurs from the mere abandonment of hotly disputed questions. We do not solve them—we get over them. Old questions are solved by disappearing, evaporating, and new questions take their place. So, doubtless, the greatest dissolvent of old questions, the greatest precipitant of new methods and problems, is the one effected by the scientific revolution begun by 'Origin of Species.'"

Some one has said, wisely, that the scrap basket of civilization is full of forgotten and abandoned problems, their day passed,

As Dr. E. F. Nichols said, in his recent inaugural address as president of Dartmouth College (Sci., Oct. 15, 1909, p. 507):

"To understand the recent history of our colleges from any point of view, the intellectual development of the world must be taken into account. . . . The middle of the last century saw the beginning of several intellectual movements. Natural science got under way earliest by establishing the doctrines of evolution and energy. The bearing of these broad principles soon became necessary to our modes of thought, as they were immediately recognized to be for our material development. To-day there is no branch of knowledge which has not in some wise been extended and enriched by the philosophical bearing of these wide-sweeping laws which at first were the individual property of natural science. So intimately have they become the guiding principles of all modern constructive thinking that, steer how we will, the man in college cannot escape their teachings. Although these principles are still most significantly presented in the laboratories in which they arose, the student will find their progeny in history, in theology and in law."

And so, to sum up, perhaps the greatest thing that can be said about evolution is that it gave to the world a new method of thought. It marked an intellectual awakening and made men think broader, deeper and more vigorously. Men have escaped from the trammels of authority and finality, and have learned to investigate for themselves and to go to the primal sources for knowledge. The dominant note in intellectual life to-day is earnestness to know the truht. There is a disposition to investigate and analyze, and the weight of mere authority is fast disappearing. But more than

that, there is that in the fundamental principles of evolution that makes men look upon life and the world differently. As we well know, evolution is but a new name for transformation, growth, development, change, such as is going on everywhere about us. That seems such a truism that it is not now worth while to be reminded of it, but the time was when it was scientific as well as religious heresy to mention such a thing. In a former stage, the pre-Darwinian era, men believed in the fixity of species and of all life, and that change was impossible. This permanency of things as a method or thought is now a thing of the past. We do not think that way now. We think in terms of evolution, of progressive and constantly improving development. Things are constantly becoming, and change, growth, evolution, is everywhere. We do not apply sixteenth century methods of thought to twentieth century life and things. The greatest gift, therefore, that evolution has bestowed upon us is liberty of thought and the idea of thinking in terms of progressive development as applied to life and things about us. We do not now care so much for the controversy about the origin of life and of the universe as we do for an insight into what it all means. What are we here for? What are we becoming in the process of our evolution? Are we worthy of the life that has been given us? Are we guiding it to its best outcome? These are thoughts that are being forced upon us as we contemplate the wonderful workings of evolution and impress us with a sense of our own appalling responsibility.